HAZARD CONTROLS: HAZARDOUS GASES

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AGENDA

1. What Are Hazardous Gases?
2. Hazard Control Requirements
3. Hazard Controls:
   • Manual Emergency Alarms
   • Gas Detection / Flame Detection
   • Automatic Shutoff Control Valves
   • Excess Flow Control Valves
   • Reduced Flow Orifice
   • Exhaust Flow Monitor
   • Abatement
   • Automatic Fire Detection (Highly-Toxic gases)
   • Seismic shutoff (TGO requirement)
WHAT ARE HAZARDOUS GASES?

• Gases that have physical or health hazards:
  – Physical Hazard: flammable, pyrophoric, oxidizing or unstable
  – Health Hazard: Highly toxic, toxic or corrosive

• HPM: Hazardous gases used in semiconductor manufacturing that are NFPA 704 hazard class 3 or 4 in health, flammability or instability.
  – If you have semiconductor fabrication or comparable research and development operations, AND you exceed the MAQ for a hazardous gas, THEN you are a Group H-5 occupancy and are covered under Chapter 27 (as well as any other applicable chapters) and controls for HPM gases apply.
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HAZARD CONTROL REQUIREMENTS

• Hazard controls for the use and storage of hazardous gases are defined in the fire code.
  – Chapter 50 Hazardous Materials applies to everybody
  – Chapters 53, 54, 58, 60, 61, 63, 64, & 66 applies to everybody as applicable
  – Chapter 27 applies to semiconductor fabrication facilities or comparable research and development operations with hazardous gas use or storage greater than MAQ
HAZARD CONTROL REQUIREMENTS

• Chapter 50:
  – Establishes minimum required hazard controls when use and storage of hazardous gases is less than MAQ (Sections 5001 & 5003)
  – Requires additional hazard controls when use and storage of hazardous gases is greater than MAQ (Sections 5004 & 5005). Plus, you are now an “H-X” facility and additional building code requirements apply.

• The above “strategy” is the same for chapters 53, 54, 58, 60, 61, 63, 64, & 66 as applicable.

• All of Chapter 27 applies if you are a Group H-5 (because you are already over the MAQ)
HAZARD CONTROLS

• Manual Emergency Alarms
• Gas Detection / Flame Detection
• Automatic Shutoff Control Valves
• Excess Flow Control Valves
• Reduced Flow Orifice
• Exhaust Flow Monitor
• Abatement
• Automatic Fire Detection (Highly-Toxic gases)
• Seismic shutoff (TGO requirement)
ALARM SIGNALING

- Manual emergency alarms shall be provided for all hazardous material storage areas - outside each exit or exit-access door (5004.9, 2703.12.1.3).

- Manual emergency alarms shall be provided in "corridors" (<150’ interval) used to transport hazardous materials having a NFPA hazard ranking of 3 or 4 (5005.4.4, 2703.12.1.2).

- Manual emergency alarms shall be provided in [H5] service corridors (2703.12.1.1)
ALARM SIGNALING

• Supervision & Monitoring (5004.10)
  – Activation shall sound a local alarm.
  – Emergency alarm and detection systems shall be electrically supervised.
  – Alarm signals shall be monitored by
    • An approved supervising station,
    • Constantly attended on-site location, or
    • Emergency Control Station (ECS).
ALARM SIGNALING

• [Gas detection] Alarms (6004.2.10.2):
  – Initiate a local alarm inside and outside the affected area.
  – Transmit a signal to a constantly attended control station.
  – Automatically close the shutoff at the source of the gas being monitored.
  – The audible alarm shall be distinct “from all other alarms”.

ALARM SIGNALING

• Problem:
  – Code does not require HazMat alarms to trigger a complete building evacuation, only “initiate a local alarm inside and outside the affected area.”
  – No code requirement for A/V location or performance, e.g. sound level, color, candela, synchronization.
  – Code does not require HazMat signal to FACP, only “transmit signal to an approved supervising station of on-site ECS”.

9. LS1.0: Delete the interconnection of the gas detection and monitoring system to the building fire alarm system. It is the City of Fire Department policy that the fire alarm system and gas detection systems shall not be interconnected. Gas
GAS DETECTION SYSTEMS

• Highly-Toxic and Toxic Gas detection systems (6004.2.10):
  – Shall be provided to detect the presence of gas at or below the PEL.
  – Shall be capable of monitoring the discharge at or below one-half the IDLH.
• HPM Gas Detection Systems (2703.13)
  – Shall be provided for all HPM gases, i.e. those having a NFPA hazard ranking of 3 or 4.
• Hazardous Gas Detection & Shutdown (5003.2.2.1(6))
  – Shall be provided for all hazardous gases, i.e. those having a NFPA hazard ranking of 3 or 4 when carried in pressurized piping greater than 15 psig.
GAS DETECTION SYSTEMS

• Where required (2703.13.1):
  – [H5] Fabrication areas
  – HPM Rooms
  – Gas Cabinets & Exhausted Enclosures
  – Corridors containing HPM gas piping

• Where required ((5003.2.2.1(6)):
  – Cylinder Distribution Racks
  – Gas Cabinets (required for highly toxics)
  – Exhausted Enclosures
  – Corridors containing hazardous gas piping

• Problem: Location of area and room detectors, required to detect short-term hazard, is very subjective.

12. Gas Detection System: Provide manufacturer’s data sheets and sensor spacing requirements for each of the detection system components.
GAS DETECTION SYSTEMS

• Level required (2073.13.2 & 5003.2.9.1)
  – IDLH within gas cabinets & exhausted enclosures
  – PEL outside gas cabinets & exhausted enclosures
  – 25% LEL within of outside gas cabinets & exhausted enclosures
LISTING REQUIREMENTS

• CFC 6004.2.10.1 Gas detection system components:
  – Gas detection control units shall be listed in accordance with UL 864 or UL 2017.
  – Gas detectors and sensors shall be listed and labeled in accordance with UL 2075.
CONTROL UNIT LISTING

• CFC 6004.2.10.1 Gas detection control units shall be listed in accordance with UL-864, or UL-2017.

• Issue:
CONTROL UNIT LISTING

• CFC 6004.2.10.1 Gas detection control units shall be listed in accordance with UL-864, or UL-2017.

• Problem:
  – UL-2017 is a specification, not a performance standard.
  – Fire alarm controls units and general purpose signaling devices are not designed or intended to provide control.
  – Only SFM listed equipment can be connected to a UL-864 FACP, whereas there are no SFM listed gas monitoring equipment.
  – Cannot be NRTL or field certified.
CONTROL UNIT LISTING

• CFC 6004.2.10.1 Gas detection control units shall be listed in accordance with UL-864, or UL-2017.

• Recommendation:
  – Gas detection control units should be listed;
    • UL-508A “Industrial Control Panels”
    • UL-698A “Industrial Control Panels Relating to Hazardous (Classified) Locations”, as applicable.
• NRTL Certified
GAS DETECTOR LISTING

• CFC 6004.2.10.1 Gas detectors and sensors shall be listed in accordance with UL-2075 Standard for Safety for Gas and Vapor Detectors and Sensors.

• Issue:
• Other code references to “listed” gas detectors and sensors
  – Hydrogen fuel gas rooms (CFC §421.6)
  – CNG motor fuel dispensing (CFC §2308.2.2)
  – Repair garages (CFC §908.5)
  – Refrigeration machinery rooms (CFC §908.6)
  – Carbon dioxide used for beverage dispensing (CFC §908.7)
  – Carbon monoxide detection systems (CFC §915.5)
GAS DETECTOR LISTING

• CFC 6004.2.10.1 Gas detectors shall be listed and labeled in accordance with UL-2075 Standard for Safety for Gas and Vapor Detectors and Sensors.

• Problem:
  – UL-2075 was written for CO detectors and combination CO/Smoke detectors for home use.
  – There are NO UL-2075 listed detectors for ANY toxic gas detector or sensor.
GAS DETECTOR LISTING

- CFC 6004.2.10.1 Gas detectors shall be listed and labeled in accordance with UL-2075 Standard for Safety for Gas and Vapor Detectors and Sensors.

- Recommendation:
  - Gas detectors shall be approved by the local authority having jurisdiction until a new standard is adopted.
  - UL working to develop a new standard for commercial/industrial gas detectors.
MAINTENANCE & TESTING

• Equipment, devices and systems shall be tested (CFC 5003.2.9)
  – Upon installation.
  – Not less than annually,
  – In accordance with manufacturer’s requirements,
  – In accordance with industry standards, or
  – In accordance with approved schedule
AUTOMATIC SHUTOFF CONTROL

• Automatic shutoff control valves shall be fail-safe to close.
• Automatic shutoff valves shall closed upon:
  – Manual Emergency Alarms
  – Gas Detection / Flame Detection
  – Loss of Exhaust
  – Loss of Power
  – Seismic detection (TGO)
  – Activation of Fire Alarm System
EXCESS FLOW CONTROL

• Excess Flow Check Valve
• Excess Flow Shutoff Valve
• Excess Flow Switch

• Imperative to size properly
  – Inlet pressure
  – Air flow rate
REDUCED FLOW ORIFICE

Minimum RFO Sizing:
- Meet process flow demand at low cylinder pressure.

Maximum RFO Sizing:
- Meet treatment requirements at full cylinder pressure.
EXHAUST FLOW

- Sail Switch
- Anemometer
- Differential Pressure
ABATEMENT

• BAAQMD - Mass based limits
  – Toxic Air Contaminates
    • Acute: lb/hour
    • Chronic: lb/year

• Fire Code – Concentration based limits
  – Highly-Toxic and Toxic Gases
    • \( \frac{1}{2} \) IDLH
  – Wet Scrubber
  – Dry Scrubber
  – Dilution
AUTOMATIC FIRE DETECTION

• Automatic Fire Detection System (6004.2.2.9)
  – Shall be provided in rooms or areas where highly-toxic gases are stored or used,
  – Shall sound a local alarm
  – Transmit signal to transmit signal to an approved supervising station of on-site ECS (inferred from CFC 5004.10 for Supervision and Monitoring of alarm signals.)
• For more information refer to:
  South Bay Piping Industry TGO Handbook
  [www.sbaypipe.org/](http://www.sbaypipe.org/)
  Link to 2014 Toxic Gas Ordinance Data Book